The Biology of the Weevil *Alcidodes mysticus* Faust (Coleoptera: Curculionidae)[1]

BY

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(*With two plates*)

INTRODUCTION

The weevil *Alcidodes mysticus* Faust was first noticed by the author attacking a variety of cotton known as Sea-island cotton (*Gossypium barbadense*) at Pattambi (south Malabar) early in October 1951. This variety, cultivated on a few islands in the West Indies, is considered to be the world's finest and costliest cotton. It was then newly introduced on the west coast of Madras State by the Madras Agricultural Department for experimental purposes. The occurrence of this weevil was noted immediately after the introduction of this cotton in the locality. It was unrecorded here previously. The grubs of the weevil were found to bore the stem, making the plants stunted in growth and reducing their yield considerably. The flowers dropped off in large numbers during the flowering period as a result of the damage done by this insect. Literature shows no reference to the biology or occurrence of this weevil in a pest form previously in India or elsewhere and this appears to be the first record of such. In view of this circumstance and of the seriousness of the pest on the newly introduced cotton, a detailed study of its biology was made by the author, and the results are presented in this paper.

HISTORY AND SYSTEMATIC POSITION

Alcidodes mysticus Faust belongs to the subfamily Alcidodinae of the family Curculionidae. The species was first described by Faust in 1894 from specimens collected in Burma. Later Heller (1911) gave a short description of the same species. As far as the author is aware, there appears to be no other reference to this species until 1953 when Tirumal Rao mentioned its discovery by the author

[1] Part of thesis submitted for the M.Sc. degree of Madras University.

in a pest form on cotton at Pattambi. The author (1957) has given a short account of its occurrence at Pattambi.

Distribution

The weevil has been collected previously from Pusa and Chapra (Bihar) and from Saidapet (Madras) as seen from the labels of specimens in the National Pusa collections. At present its distribution in south India is known to be only south Malabar, where for the first time it has been found as a pest. In his original description Faust mentions the place of collection as Burma.

Host Plants

On the specimens in the National Pusa collections the host mentioned is cotton. At Pattambi the weevil was noted attacking the varieties of cotton known as Sea-island (*Gossypium barbadense*), Cambodia CO2 (*Gossypium hirsutum*), and also the hybrid of these two cottons. A vigorous search was made for alternate hosts of this weevil in the surrounding places near Pattambi. Although it was not found breeding on any other plant, a few adults were collected on *Urena lobata* L., *Urena sinuata* L., and *Malvastrum coromandelianum* G.

Nature and Symptoms of Damage

The adult weevils feed on leaf buds, petioles, and tender terminal portions. They make small pits during the process of feeding and egg-laying on tender shoots. The damage done by the adults is very insignificant. It is the grubs that do serious damage to the crop by boring the stem and petioles. The adult weevils lay eggs in petioles of leaves and at the terminal portions. The grubs that hatch out bore into the petiole and gradually reach the main stem, and from there they bore downwards. At frequent intervals the grubs make exit holes at the sides of the stem and petiole to send out the frass. A large number of grubs bore the stem and feed on the contents, causing a stunted growth of the crop. In the early stages of the crop the attack can be made out by the wilting of tender leaves which in course of time gradually dry and fall off. In an infested field during the earlier stages of the crop a large number of plants with such wilted and drooping leaves can be seen. In a later stage the attack can be easily made out by the presence of small exit holes in the stem and petioles plugged with brownish powdery frass. Attacked plants look stunted and sickly. At the flowering stage, a number of flowers drop off reducing the yield considerably. A single attacked plant may harbour as many as 16

grubs. In one single plant about 27 grubs were collected in November 1952. In severe attack more than 80% of the plants were found infested with the insect. A loss to the extent of 12 to 15% in the yield was noted due to the damage of this weevil at Pattambi.

Life History and Descriptions of Various Stages

There is no literature on the biology and life-history of this weevil. Hence the detailed life-history was studied for the first time in the years 1951 and 1952 by the author.

The entire life-history is completed on the plant itself.

Copulation. The weevil is very rarely seen in copulation in the field. However, they were found freely copulating under laboratory conditions. The copulation in several cases was found to last for 20 to 30 minutes. The time from emergence to copulation varied with individuals and the minimum period was noted to be three days and the maximum six days. Several males were observed to copulate with the same female during the course of the day.

Pre-oviposition period, period of oviposition and fecundity. The pre-oviposition period was found to vary from 8 days to 14 days with an average of 10.4 days for 25 individuals. The weevils were found to lay very few eggs in captivity. The maximum of eggs laid was 38 in the course of 33 days. The daily range was found to be 1 to 3 eggs. The period of oviposition was noted to be very short in the laboratory, the maximum period being only 33 days. The total number of eggs laid varied from 9 to 38 with an average of 20. Under field conditions probably the rate of egg laying may be higher.

Place and method of oviposition. Eggs are usually laid at the tender terminal portions of the plant and under the leaf petioles; sometimes also on the thick veins of big leaves. The weevil makes excavations, the depth of which is as long as the rostrum, and lays eggs in them. In very many cases it was found that three such excavations were made close to each other at a particular place, and that in all cases only the centre one contained the eggs. As a rule only one egg is laid in an excavation, and in no case were two eggs noticed in a single hole. After finishing egg-laying the hole was covered with the material that was scooped out by the weevil. The time taken for laying a single egg was noted, in several cases, to range from 15 to 18 minutes.

Egg

Pale white, chorion smooth, glossy, broadly oval. A freshly laid egg measures on an average 0.99 mm. in length and 0.59 mm. in

ALCIDODES MYSTICUS Fst.

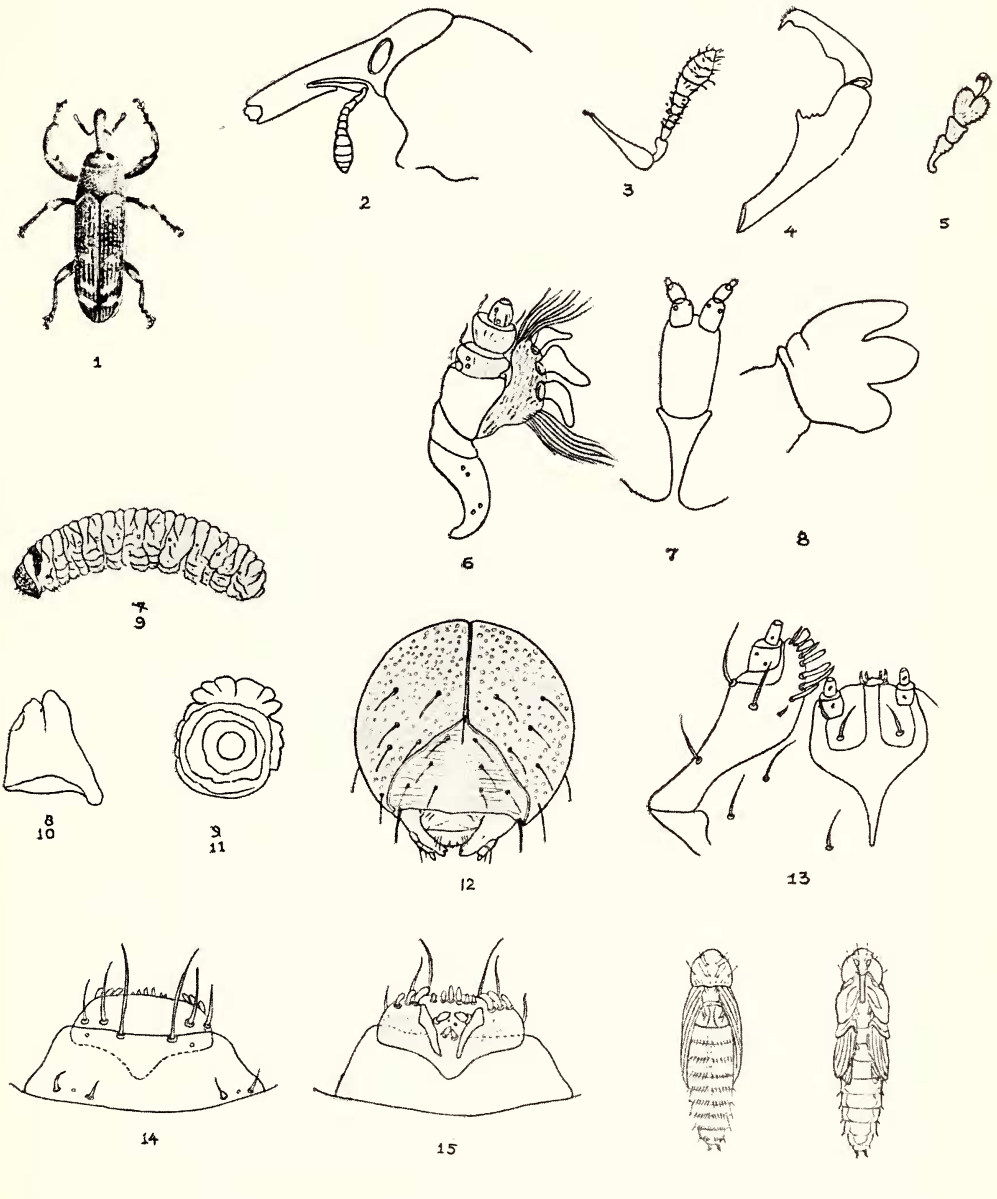

Fig. 1. Adult ; 2. Side view of head ; 3. Antenna : 4. Front femur and tibia ; 5. Tarsus ; 6. Maxilla (adult) ; 7. Labium (adult) ; 8. Mandible; 9. Grub ; 10. Mandible (grub) ; 11. Spiracle (grub) ; 12. Head capsule (grub) ; 13. Maxilla and Labium (grub) ; 14. Labrum (grub) ; 15. Epipharynx (grub) ; 16. Pupa (dorsal and ventral views).

Fig. 1. Leaf petiole of Sea-island cotton showing the weevil attack

Fig. 2. Infested Stems

width, the length ranging from 0.96 to 1.1 mm. and width from 0.56 to 0.61 mm. Newly laid eggs are white, fragile, while older eggs are harder with brittle chorion. As it develops the egg swells up slightly and the brown mandibles of the embryo become visible after three days. No change in colour is noted until hatching.

Incubation period. Under laboratory conditions when the average maximum and minimum temperatures and humidity were 87.2° F., 78.1° F., and 77.6% respectively, the incubation period of 50 eggs was found to vary from 6 to 7 days, with an average of 6.5 days.

Grub

The number of the larval instars, the moulting activities, and the duration of each instar were studied in detail. The grub was noted to pass through eight instars in the laboratory. The description and duration of each instar with reference to 25 individuals are given below. There is not much difference in general characters between these instars, except in the measurements of the body and head which vary, and also a slight change in the coloration of the head capsule.

First instar: Length of body 1 to 1.5 mm.; width 0.55 mm.; length of head 0.45 mm.; width 0.45 mm.

Colour pale yellow. *Body* curved and sparsely baset with hairs; slightly broader anteriorly. Apodous. *Head* pale brown, smooth; frons with a small median dark line on the posterior end; mandibles dark brown and prominent and bifid.

The duration of the first instar was found to be six days for all the individuals.

Second instar: Length of body 1.8 to 2.2 mm.; width 0.75 mm.; length of the head 0.58 mm.; width 0.53 mm. Characters similar to previous instar.

The duration of the second instar varied from 6 to 7 days with an average of 6.1 days.

Third instar: Length of body 2.5 to 3.2 mm.; width 0.8 mm.; length of head 0.72 mm.; width 0.63 mm. *Head* light brown, smooth. *Pronotum* pale testaceous. Other characters similar to the previous instar.

The duration of this instar varied from 6 to 7 days with an average of 6.1 days.

Fourth instar: Length of body 3.5 to 4.5 mm.; width 0.8 mm.; length of head 0.84 mm.; width 0.78 mm. *Colour* pale yellow as in previous instars. *Head* deep brown and finely punctate.

Prothorax testaceous brown. Other characters similar to the previous instar.

Fifth instar: Length of body 4.5 to 5.0 mm.; width 1.2 mm.; length of head 1.1 mm.; width 0.92 mm. General characters similar to fourth instar.

The duration of the fourth and fifth instars varied from 6 to 7 days with an average of 6.3 days.

Sixth instar: Length of the body 5.0 to 5.5 mm.; width 2.0 mm.; length of head 1.26 mm.; width 1.15 mm. *Colour* as in previous instars. *Head* dark castaneous and coarsely pitted. The testaceous colour of the prothorax is very distinct.

The duration of this instar varied from 6 to 7 days with an average of 6.4 days.

Seventh instar: Length of body 5.5 to 7.0 mm.; width 2.0 mm.; length of head 1.4 mm.; width 1.34 mm. *Colour* creamy yellow. *Head* dark castaneous, coarsely pitted. The testaceous colour of pronotum very prominent. Other characters similar to previous instars.

The duration of this instar varied from 6 to 8 days with an average of 6.9 days.

Eighth instar: (Full-grown grub).

Length of body 7.5 to 10 mm.; width 2.4 mm.; length of head 2.1 mm.; width 1.50 mm.

Larva apodous. *Colour* creamy yellow. *Body* stout, cylindrical, moderately curved and wrinkled. Head capsule chitinised, dark castaneous, entire mouth frame and mandibles much darker, subcircular, length slightly exceeding width, surface deeply pitted; cheeks broadly rounded. *Epicranial suture* distinct, slightly exceeding half cranial length. *Frontal sutures* distinct, each arm slightly exceeding epicranial suture in length, sinuate; each side of epicranium provided with seven setae. *Frons* sub-triangular with some transverse sculpture on the surface and a dark streak on the posterior end which extends forward to about one-fourth length of frons, one and one-fourth times as broad as long, length equal to epicranial suture; provided with five pairs of setae. *Ocellus* one pair on each side along with a smaller posterior spot. *Antenna* small, two jointed, apical segment conical and longer than wide. *Clypeus* about twice as wide as long with two pairs of setae on the posterior margin. *Labrum* transverse, length about half of width and three-fourths of clypeus, posterior margin prolonged into clypeal zone, upper surface carrying three pairs of setae, the median pair longest. *Epipharynx* with a pair of slender and slightly converging rods which extend into the clypeal zone, the anterior margin with six median setae and three lateral

setae on each side; between the rods are two pairs of small setae, the anterior pair much stouter and more widely separated than the posterior pair; in addition a pair of tripartite pores are found between the rods. *Mandibles* strong, subtriangular, bluntly bidentate, shorter than basal width and dark brown in colour. *Maxillae* elongate, terminated by a two jointed palpus and a setose lacinia; *Cardo* smooth; stipes longer than broad with a basal latero-ventral setae and two setae in the palpiferous region; palpus two jointed, basal joint as long as wide and twice as long as the apical joint with a pair of sensory pores. The apical joint is one and a half times longer than wide and provided with one small sensory pore at the base and small sensory pegs at the tip; mala simple, with 9 to 10 long dagger-like setae and another small seta at the posterior end. *Labium* as long as wide, posteriorly limited by a Y-shaped chitinised band and with one pair of long setae on each labial stipe; palpus two jointed each with one small sensory pore, basal joint slightly wider than long, apical one equal in length to the basal joint and one and half times longer than broad and provided with sensory pegs; ligula with two pairs of setae anteriorly; subfascial area entire with three setae on each side.

Thorax. *Prothorax* strongly transverse, dorsally not divided but the two areas prescutal and scutal are roughly indicated by rows of setae; pronotum testaceous brown. *Meso- and meta-thoracic* region divisible into two distinct areas dorsally, namely prescutum and scuto-scutellum; the prescutum provided with two small setae and scuto-scutellum with four setae in a straight line. Pedal lobes prominent and provided with four or five hairs.

Abdomen. Ten-segmented, segments 1 to 8 similar in shape and size with three distinct transverse folds namely prescutum, scutum, and scutellum; a weakly formed inter-segmental fold is also visible. The prescutum is provided with one pair of setae, scutum with one tiny seta, scutellum with four setae in a row; alar area provided with two setae. Each epipleural lobe of abdomen is provided with a single seta and each hypopleural lobe with two setae; the last two abdominal segments simple with a number of setae. *Spiracles* present, one between pro- and meso-thorax and eight in the abdominal segments 1 to 8 on each lateral side, size moderate, circular, air tubes irregular and short and do not project far beyond peritreme, posterior spiracles placed more dorsally.

The duration of the eighth instar varied from 6 to 8 days with an average of 6.9 days.

The total larval period for the 25 individuals varied from 48 days to 52 days with an average of 50.5 days in the laboratory.

Larval habits. Soon after hatching the grub starts feeding on the tissue immediately around the hole in which the egg was laid. Then it starts boring downwards in the case of the main stem, whereas if the egg is laid in petioles, the grub starts boring the petiole and gradually reaches the nodal region from where it travels downwards into the main stem. It makes, at intervals, small exit holes on the petiole and stem as it advances. The distance varies between each hole, usually being shorter at the beginning and gradually increasing as the grub advances in growth. Through these holes it throws out the frass. By nature the grub is very sluggish. Before pupation it prepares a small cavity inside the stem, just bigger than the length of the pupa.

Prepupa

This stage is characterised by the shortening of the grub in length, and the slight swelling in the thoracic region. The length of this stage is about 8.9 mm., and the period lasts for about 48 hours.

Pupa

Average length of the body 8.9 mm.; width 2.5 mm.

General colour creamy yellow, but turns still darker before its transformation into adult. *Body* soft, beset with moderately long hairs which are concolorous with the body. *Head* as long as broad and provided with five pairs of setae originating from minute tubercle as follows: one pair near the base, two pairs immediately behind the eyes, and two tiny pairs between the eyes. *Rostrum* about one-fourth total length of body and three times as long as its greatest width, pressed against thoracic sterna, bears two pairs of setae in small tubercles, the posterior pair close to the eyes, and the anterior pair between the position where the scape is inserted. *Antennae* geniculate, concolorous with the body, with indistinct segments, inserted in the middle of the snout.

Prothorax occupies one-fifth total length of the body, about one and a half times as wide as long, provided with nine pairs of setae raised on tubercles consisting of two anterior pairs, three median pairs, and four posterior pairs. *Mesothorax* half as long as prothorax; width about twice its length; bears two pairs of setae. *Metathorax* one and a half times as long as broad, and provided with three pairs of small setae.

Abdomen twice longer than broad, nine segmented; segments 1-8 have dorsally a transverse row of six pairs of setae on small tubercles on the posterior margin which consists of two median pairs, four lateral pairs; in addition one pair on the pleural region. The ninth

segment is provided with a pair of slender, pointed, curved pleural process.

Pupation takes place inside the larval burrow in the stem. The duration of the pupal stage varied from 9 to 11 days with an average of 10.4 days for 25 individuals.

The total life cycle from egg to adult for this weevil varied from 64 to 70 days with an average of 68.4 days.

Adult

The original description of the adult by Faust (1894) is as follows:

'Elongatus, subcylindricus niger; fronte rostro parum angustiori, medio foveola abbreviata impressa, antice carinulato rostro subrecto, basi densius fortiterque punctato; prothorace latitudine nonnihil breviore, basi profunde bisinuato, apice subtruncato, lobis ocularibus rotundato-productis, basin versus subparallelo; antice sinuato angustato, supralongitudinaliter convexo, minute granulato; elytris prothorace haud latioribus, fasciis duabus transversis abbreviatis cinereosquamosis, a basi usque ad fasciam secundam striato-fovego latis, interstitiis angustis irregulariter punctatis pectore rugosepunctato hinc inde granulis parvis immixtis. Long 7-10, lat 2-2.6 mm. Bhamo.'

Since Faust's original description is brief, and based on only a very few specimens, the species is redescribed here in greater detail based on a larger number of male and female specimens collected.

Female

Form subcylindrical, integument piceous, not very densely clothed with small pale scales, more or less dusted with rust red powder. *Elytra* with pale markings formed of small short greyish white plumose scales, one small patch just beyond the middle extending from stria 3; another narrow oblique and extending from the suture to the lateral margin just above the apical region and in addition an indefinite preapical band which is broadly interrupted on the suture.

Head closely punctate, a little broader than long; forehead with a shallow median fovea, and with an impressed line round the upper edge of each eye. *Rostrum* elongate, subcylindrical, shorter than front femur, longer and slender, slightly widened at the insertion of the antennae and again at the apex; coarsely punctate at the basal half, but much finner apically. *Mandibles* dark brown, tridentate, as long as broad. *Maxillae* elongated, freely exposed; palpus three segmented, segment 1 twice as broad as long, 2 about twice as broad as long, apical segment half as long as basal segments and as long as broad, small and bluntly conical; palpifer stout, longer than broad, as long,

as the first two segments of palpus; stipes as long as first segment of palpus; cardo stout and curved posteriorly, as long as all the three segments of palpus put together; lacinia with prominent bristles and lacinial teeth. *Labium* with three segmented palpi, segment 1 longer than broad, 2 about twice longer than broad, 3 very small, length half of segment 2 and twice longer than broad. *Mentum* stout, twice longer than broad. *Submentum* pedunculate. *Antennae* inserted in the middle; the scape as long as funicle which is 7 jointed, joint 1 as long as 2 plus 3, 3 to 6 bead like and transverse, 7 as long as the first two segments of club; club conical, twice as long as broad, 4 segmented and covered with grey hairs.

Prothorax broader than long, widest at the base, subconical, parallel sided from the base to the middle, roundly narrowed and broadly constricted at the apex; the post ocular lobes rather feeble, the dorsal outline slightly convex, the whole prothorax being tilted upwards anteriorly; dorsum set throughout with separated and much flattened granules except the apical area which is closely and shallowly punctate; *Scutellum* small not enclosed in front, pyriform, broadest behind, bare and with a shallow median impression. *Elytra* cylindrical, not broader at the shoulders than the prothorax, with a broad shallow transverse impression at the base behind scutellum; about three and half times longer than broad, apices separately rounded; striae containing large deep punctures each containing a seta but most of them more or less filled up with scaling or powdering, which are reduced behind the narrow pale band, intervals rather narrower than striae, rugosely punctate with small setiform scales. *Hindwings* about four times as long as broad, hyaline with light brown veins. *Legs* dark piceous with coarse shallow punctures each of which contains a scale; the front femora with an elongated vertical tooth in the middle and three indistinct denticulations in front of it, that on the posterior ones having only one simple tooth; the front tibiae gently curved externally and with an obtuse-angled tooth behind the middle and a sharp prominent tooth at the apex, the posterior ones with a tooth only at the apex, tarsi four segmented, joint 3 bilobed, 4 curved and ends in four small spines; the hind pair of legs distinctly smaller than the other two. *Sternum* with front intercoxal space narrower than median one, the sculpturing of the metasternum concealed by the scaling. *Abdomen* about one and half times longer than broad, surface reticulate and covered with minute hairs.

Measurements (in millimetres): Length of body with rostrum 9.2, width 2.2, rostrum 2.1, antenna 1.8; prothorax 1.9, width 2.2; elytra 5.1, width 1.5; hind wing 6.8, width 1.8; abdomen 2.7, width 1.8 (average of 25 specimens).

Male

The male is similar in general characters to female. Differences are found only in the following: the rostrum of male is short and more stout, and further coarsely punctate throughout; average size of male is shorter than female.

Measurements (in millimetres): Length of body 8.8, width 1.9; rostrum 1.8; antennae 1.5; prothorax 1.6, width 1.9; elytra 3.5, width 1.2; hind wing 5.2, width 1.4; abdomen 2.1, width 1.4 (average of 25).

Emergence

The adults emerge through the holes made by the full-grown grubs on the stem before pupation. As soon as they emerge they are very soft and delicate but get hardened in one or two days.

Habits

The adults are generally less active. They are often found clinging to the terminal branches, especially at the axils of leaves in the fields. If approached they try to hide beneath the leaves and a slight disturbance makes them fall down and feign death and in this posture they remain for about 20 to 30 minutes. They are rarely seen in the field in copulation. They feed on tender portions of the stem. Though provided with fully developed wings they are not often found to fly from place to place.

Longevity

The length of life of adults of both males and females were studied under laboratory conditions with and without food taking 25 individuals under each sex. The length of life of both the sexes was short under captivity. Unlike in the case of a number of other weevils this weevil was found to die soon under captivity. The duration of life with food varied from 8 to 37 days with an average of 23.2 days in the case of males, and 15 to 38 days with an average of 23.0 days in the case of females. Without food it varied from 4 to 12 days with an average of 6.6 days for females, and 3 to 13 days with an average of 6.3 days for males.

Sex Ratio

The exact sex ratio has not been ascertained but throughout the period of the investigation individuals of both sexes were available in large numbers and males were roughly as numerous as the females.

Natural Enemies

During the course of this study a few grubs were found to be parasitised by the Braconid *Bracon greeni* Ash. in the field. The parasitism was, however, very low. This was the only parasite noted during the study. Apart from this, the small red ants *Solenopsis* sp. were found to enter through the exit holes on the stem and destroy the grubs in a few plants.

Seasonal History

The seasonal history of this weevil was studied at Pattambi. The Sea-island cotton is sown in mid-June at the break of monsoon, and removed by the end of December. Only one generation of the weevil was noted during this period. The egg laying commences by the end of July and continues up to October (maximum in August and September). The adults emerge towards the end of November and in December. The small and medium sized grubs are seen from the middle of August to the end of October, and the full-grown grubs and pupae in November. Most of the adults emerge by the middle of December. The weevils continue to feed as long as the twigs are green but when the crop is pulled out, they enter into hibernation and remain in that condition up to the end of June. They have been found hibernating in all sorts of locations—beneath debris, under bark of trees and on shoots of other wild plants like *Urena lobata* and *Urena sinuata*. Mortality during hibernation is high. Early in July the weevils emerge from hibernation, and start egg laying and feeding during the middle of July on the cotton.

In 1951 the crop was left in the field after picking was over in December as a ratoon crop. In this case a second generation of the weevil was noted from May to August 1952 affecting the ratoon crop. Egg laying was noted in fresh shoots which developed in May after the receipt of summer showers. The second generation adults emerged in the middle of July and early in August, which in turn attacked the newly raised main season crop.

Intensity of Attack on different Varieties of Cotton at Pattambi

Observations were made on the intensity of damage done to four varieties of cotton, namely Sea-island, Cambodia CO2, Hybrid of Sea-island × Cambodia, and Moco, in the year 1952. Under each variety a plot of equal area was marked out in the field and the number of infested and healthy plants were recorded in each month from September to December. The details are furnished in the following table: